Chapter 11

11.1 Asphalt and Concrete Pavements

a) Since concrete and asphalt road beds have different life spans, they cannot be compared directly over one life span each. They can be considered over multiple life spans, repeating the projects until a common multiple of years is reached. Practically, this can be done by finding close multiples around 30 or more years, since the present values of sums further in the future are insignificant. The calculations may be quickly performed by considering the difference between the two cash flows. Choosing 3 life spans for asphalt and 2 for concrete (51 and 54 years respectively) gives sufficiently close projects lives.

Figure S11.1 gives the cash flow of the costs and savings of initially choosing concrete over asphalt, in terms of $ per square yard. The initial extra cost of the concrete is 21-17.80 = $3.20. Note that by focussing on the incremental difference of one alternative over the other, rather than on each separately, there are fewer and simpler calculations.

NPV (concrete over asphalt):

$$= -3.20 + 17.8(.1978) - 17.8(.0763) + 17.8(.0391)$$

$$= -0.341 \text{ \$ per square yard}$$

For concrete to be as inexpensive as asphalt, the cost of concrete must be reduced by 0.341 $\$/yd^2$. At $20.659 per square yard, NPV = 0, and both materials have equivalent costs over time.

b) The costs are equal when NPV of the cash flow equals zero.

For $r = 9\%$ $\quad$ NPV = +0.127 $\$/yd^2$

$r = 10\%$ $\quad$ NPV = -0.341 $\$/yd^2$

By interpolation, asphalt also equals concrete in cost at $r = 9.3\%$.

c) If the government pays one half of the initial cost of the road:

$$NPV = -0.341 + (3.20)/2 = 1.26 \ \$/yd^2$$

So choose concrete.

If the discount rate is 6%, then NPV = $2.17 $\$/yd^2$ so choose concrete.

Choose concrete when NPV is positive. Figure S11.2 illustrates the <u>difference</u> in costs between concrete and asphalt road beds.

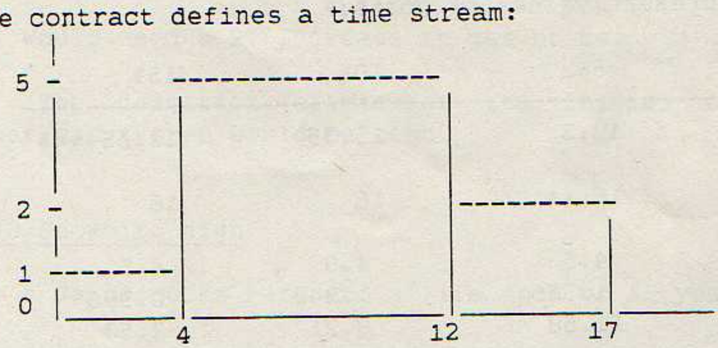
11.2 New Car

a) $16840.51

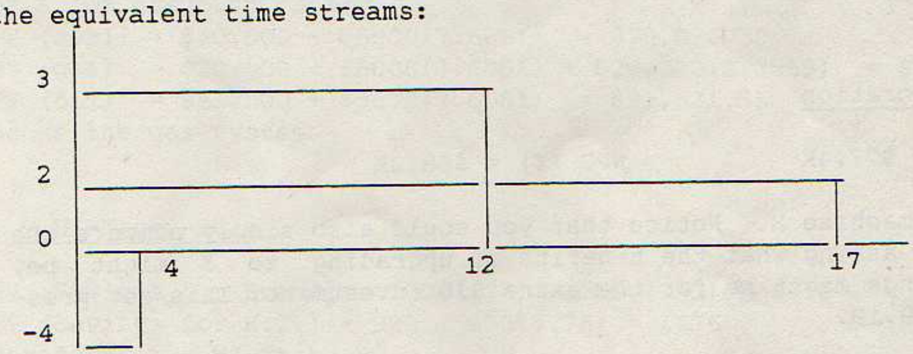
b) $16011.07

11.3 Patent Sale

The contract defines a time stream:



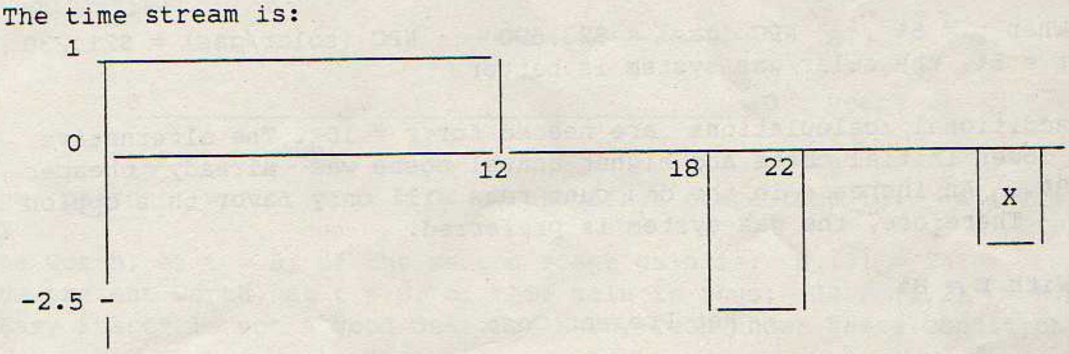
At t = 2, company wants to know maximum investment which is less than or equal to the then present value at 16% of the remaining time stream. This can be obtained directly from the above time stream or, more easily if you are not working with a spread sheet program, from the equivalent time streams:



The answer is: 19,229.66.

11.4 Trust Fund

The time stream is:



The process requires one to calculate the lump sum worth of the two time streams to some convenient time (say t = 12 and t = 22 respectively) and then to get the net future value of these amounts at t = 30. We find that x = 26,821.14.

11.5 Ace Woodworking, Ltd.

The table shows the net present values of costs:

Operation		5%	10%	15%
Manual		19.3	15.35	12.55 ***
IBM		16 ***	16	16
HAL	capital	4.5	4.5	4.5
	repair	1.566	1.242	0.996
	O and M	11.58	9.21	7.53
	Total	17.646	14.952 ***	13.026

The cheapest solution for each discount rate is starred. Notice how it progresses from initial to deferred costs as the discount rate increases.

11.6 XYZ Corporation

a) NPC (X) = $77.4K NPC (Y) = $68.2K

b) Choose machine X. Notice that you could also simply compare the alternatives, asking what the benefits of upgrading to Y might be, what the savings might be for the extra $10 investment. This net present value = $9.19.

11.7 Ren O'Vait

a) NPC (gas) = $19,730 NPC (solar/gas) = $19,910
Choose the gas system

b) When r = 5% , NPC (gas) = $23,690 NPC (solar/gas) = $21,230
For r = 5%, the solar/gas system is better

No additional calculations are needed for r = 10%. The alternative with lower initial costs and higher annual costs was already cheaper at 8%. An increase in the discount rate will only favor this option more. Therefore, the gas system is preferred.

c) With r = 8%

Net Present Cost

Horizon	Gas	Solar/Gas
15	17,840	19,280
25	21,010	20,340

d) NPC (gas) = NPC (solar/gas)

$5000 + 9.82(100) + (9.82)1400x = 15000 + 9.82(300) + (9.82)200x$

$x = 1.02$

Would need a 2% increase in gas prices

e) The deduction eliminates the initial cost. Therefore, the solar/gas system would be best.

11.8 Snowbird High

For a 7% discount rate and a life span of 15 years:

NPV (coal) = \$40,000 + \$5000(8.5595) = \$82,797.5
NPV (gas) = \$20,000 + \$6000(8.5595) + \$20,000 (0.4632) = \$80,621
NPV (oil) = \$65,000 + \$3500(8.5595) = \$94,958.25
Choose the gas system

For a 10% discount rate:
NPV (coal) = \$40,000 + \$5000(7.6061) = \$78,030.50
NPV (gas) = \$20,000 + \$6000(7.6061) + \$20,000(0.3855) = \$73,346.60
NPV (oil) = \$65,000 + \$3500(7.6061) = \$91,621.35
Choose the gas system

11.9 Hi-Tacky PC's

NPV (Savings for Brand) = 1000(.75) + 1000(.56) = 1310
NPV (Savings for H.T.) = 900 + 100(5.76) = 1476
Therefore, buy Hi-Tacky PC.

11.10 Balloon Payment

a) The differential cash flow for the "Easy Start" as compared to the "Regular"is:

```
                       ---------------------  8
                       |
0_____________________5____________________10   years
                       |
---------------------                          -4
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The present worth, at t = 0, of the first stage loss is: -4 (3) = -12

The worth, at t = 5, of the second stage gain is: 8 (3) = 24

The present worth, at t = 0, of this gain is thus: $24 / (1.2)^5 = 9.64$

"Easy Start" is not a good deal for Ready-Tech under these conditions

b) When initial payments are \$7,000 a year, the present worth of the loss over "Regular" is: -3 (3) = -9 < 9.64

"Easy Start is then a good deal.

11.11 Size that Project!

a) With $N = 7$, $rN / (e^{rN}) = 0.7 / 1.01 \sim 0.7$. Therefore, 7000 m^2

b) $N^* = 22$, Therefore, 1,100 acre-ft.

c) Same value of rN will solve the equation as in (b). Therefore, as r doubles, N becomes half, N = 11

d) $N^* \sim 2$

11.12 Second Hand Car

a,b) The nature of the effect of changing discount rates can be explored by considering extreme values, in this case 0% and infinite %. The table gives present values in ($\$ \times 10^3$). Optimal choices are starred.

Option	PV at 10%	PV at 0%	PV at infinite %
Used	- 10.58 **	- 13	- 3
New	- 11.83	- 10 **	- 13
Lease	- 11.37	- 15	0 **